Journal of Rural and Community Development

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**Citation:**
Looker, E. D. (2021). The COVID-19 vulnerability landscape: Susceptibility to COVID-19 across rural versus urban health regions of Canada. *The Journal of Rural and Community Development*, *16*(4), 1–27.

**Publisher:**
Rural Development Institute, Brandon University.

**Editor:**
Dr. Doug Ramsey



ISSN: 1712-8277 © Author
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# The COVID-19 Vulnerability Landscape: Susceptibility to COVID-19 Across Rural Versus Urban Health Regions of Canada

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## Abstract

Rural communities are often portrayed in the research literature and popular media as being disadvantaged and 'vulnerable'. This paper examines the extent to which rural health regions in Canada are more vulnerable than other health regions in terms of contracting COVID-19 and developing serious illness from this virus that leads to death. Data include published numbers of cases of and deaths from COVID-19 in each health region across Canada. Other data from Statistics Canada's Canadian Community Health Survey (CCHS) documents the higher rates of 'vulnerability' in rural health regions, according to (a) their socio-demographic conditions (income, education, age), and (b) the rates of 'underlying health conditions' which would make individuals more susceptible to serious illness from COVID-19. Despite these vulnerabilities, which are consistent with other research on rural areas in Canada, COVID-19 rates are found to be higher in metropolitan areas—although there is some variation in this pattern by province. In no provinces is the rate of death per case of COVID-19 highest in rural areas. Overall, in Canada, deaths per case from COVID-19 are higher in metropolitan than in rural health regions, challenging the notion of rural areas being only and always disadvantaged.

**Keywords:** rural, health, COVID-19, Canada

ISSN: 1712-8277 

# Le paysage de la vulnérabilité à la COVID-19: Susceptibilité à la COVID-19 dans les régions socio sanitaires rurales et urbaines du Canada

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## Résumé

Les communautés rurales sont souvent décrites dans la littérature de recherche et les médias populaires comme étant défavorisées et « vulnérables ». Ce document examine dans quelle mesure les régions sanitaires rurales du Canada sont plus vulnérables que les autres régions sanitaires en termes de contracter la COVID-19 et de développer une maladie grave, causée par ce virus, et entrainant la mort. Les données comprennent les nombres publiés de cas et de décès dus à la COVID-19 dans chaque région sanitaire du Canada. D'autres données de l'Enquête sur la santé dans les collectivités canadiennes (ESCC) de Statistique Canada documentent les taux plus élevés de « vulnérabilité » dans les régions sanitaires rurales, selon (a) leurs conditions sociodémographiques (revenu, éducation, âge) et (b) les taux de « conditions de santé sous-jacentes » qui rendraient les individus plus susceptibles aux maladies graves dues à la COVID-19. Malgré ces vulnérabilités, qui concordent avec d'autres recherches sur les régions rurales du Canada, les taux de COVID-19 sont plus élevés dans les régions métropolitaines, bien qu'il existe certaines variations dans cette tendance selon la province. Dans aucune province, le taux de décès par cas de COVID-19 n'est le plus élevé dans les zones rurales. Dans l'ensemble, au Canada, les décès par cas de COVID-19 sont plus élevés dans les régions métropolitaines que dans les régions sanitaires rurales, remettant en cause la notion de régions rurales étant uniquement et toujours défavorisées.

**Mots-clés:** rural, la santé, la COVID-19, le Canada

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## 1.0 Introduction

There has been widespread concern among analysts and policy makers about the vulnerability of certain groups of individuals to the COVID-19 virus. Rurality has seldom been mentioned in these discussions, despite the fact that a wealth of research documents the health vulnerability of rural residents. Laurent (2002, Report PRB 02-45E, p. 1) cites the comment by the Special Advisor on Rural Health that "if there is two-tiered medicine in Canada, it is not rich and poor, it's urban versus rural."

This paper examines the vulnerability of those living in rural versus urban areas to negative health outcomes specifically because of COVID-19. After a review of the relevant literature on rurality and health, we examined recent data documenting:

ISSN: 1712-8277 

(a) rural-urban differences in cases[1] of COVID-19, (b) socio-demographic factors that have been linked to higher susceptibility to serious illness from COVID-19, and (c) health conditions that can contribute more directly to this susceptibility. Finally, we present data on rural-urban variation in deaths per case of COVID-19.

The key components of rurality are low density and long distance from high density (Bollman & Reimer, 2018, p. 20; Bollman & Reimer, 2019; World Bank 2009). It matters how these dimensions are applied and how areas are divided into categories of 'rural versus urban' (Koifman et al., 2016; Looker, 2021; Williams & Kulig, 2012). Grouping large areas into 'health regions' makes sense when looking at health data—as we are doing in this analysis. Nevertheless, it is important to recognize that health regions are heterogeneous and may mask some place effects (Sibley & Weiner, 2011, P. 9; see also Pampalon et al., 2010; Tremblay et al., 2002). Several researchers reinforce the important caveat that there is considerable diversity in rural areas (Subedi et al., 2019; Williams & Kullig 2012). Eberhardt and Pamuk (2004) remind us that "rural-urban health patterns are not always monotonic" (p. 1682). More recently Breen (2021) warns that "treating rural communities as a monolithic entity conceals the range of experiences across rural communities…[and]…there is far more than a single rural story" (p. 2).

That said, there is considerable documentation that rurality is linked with poorer health outcomes, in Canada and elsewhere. According to Lavergne and Kephart (2012) "residents of Canada's rural and remote areas generally show a health disadvantage relative to their urban counterparts" (p. 2). DesMeules & Pong (2006) and Schuurman (2009) also discussed this. Wilkins (1992) talked about how disability rates are higher in smaller communities. DesMeules & Pong (2006) note a clear gradient in mortality from urban to rural.

So how can, and how do density and distance from density—the defining characteristics of rurality, (see Bollman & Reimer, 2018)—affect rates of contracting and dying from COVID-19? There are three key issues that would affect the susceptibility to serious illness or mortality from this virus. One is the *likelihood of contracting the virus*. Are there rural-urban differences in exposure to and testing positive for this virus? A second is the presence of *underlying conditions* that increase the likelihood of developing serious symptoms that require hospitalization and can lead to death. Do those living in rural versus urban areas have more underlying health conditions that increase their susceptibility to developing serious illness, and dying from the disease? The third is *access to treatment* for the disease once identified. How does access to key medical facilities vary for rural as compared to urban areas? These are questions this paper will attempt to address.

One way in which rural–urban location can affect exposure to the virus reflects the 'low density' characteristic of rural areas. Low density, by definition, means you are near fewer people. Urban areas, with high density buildings, high density shopping areas, high density transportation systems, high density sporting and entertainment venues might then be expected to generate higher COVID-19 risk for urban residents. Some recent reports (Firdaus, 2018) do suggest that "dense populations in urban counties are at increased risk" to contracting the virus (Debopadhaya et al., 2021, P. 1). However, there is also the issue of the location in rural areas of high-

[1] It is important to note the caveat that the data on COVID-19 cases and deaths per case are based on information available May18–21, 2021. It is possible, perhaps likely, that there have been important changes in the distribution of cases and deaths per case since that time.

density workplaces, such as meat packing plants (Weeden, 2021), and work-in sites such as the oil sands, that have contributed to outbreaks of COVID-19. Overcrowding in the home environment would also contribute to increased risk of transmission of COVID-19. Such overcrowding has been shown to be high in some urban areas (Firdaus, 2018) but also some rural communities, especially within First Nations communities (Brittain & Blackstock, 2015; Frolich et al., 2006; Tremblay et al., 2002).

Some differences have to do with the essence of rural versus urban areas. For example, smog concentrations (Debopadhaya et al., 2021) tend to be more of an issue in larger urban centers than in sparsely populated rural areas. Exposure to agricultural pesticides or the risks associated with the need to drive long distances are issues for rural residents. These differences are inherent in living in an urban or a rural area.

A second way in which the rurality of your community can affect your health has more to do with the socio-demographic correlates of living in a rural or an urban area in a western industrialized country such as Canada. For example, a higher percentage of the rural than the urban population tends to be elderly, and elderly people tend to be at greater risk for certain diseases or greater risk of serious illness if they do contract an illness. It is not the fact of living in a rural area, per se, that puts the person at risk, but rather their age—which would be a risk wherever they lived. Similarly, certain occupations have higher risks of certain diseases—lung disease for miners, stress related illnesses for certain high-pressure occupations—and the rural-urban distribution of jobs in those occupational sectors is reflected in the rural–urban rates of those occupationally related diseases.

So, what do we know about the prevalence of underlying socio-demographic or health conditions that could affect the incidence of COVID-19 and/or serious illness and death from this virus, in rural as compared to more urban areas?

As noted above, a key factor in the susceptibility to many health conditions is age. Older individuals often have poorer health (Tremblay et al., 2002), and rural areas in Canada and elsewhere tend to have more older residents—those over 65 years of age (Bollman, 2022; Dobis & McGranahan, 2021; Laurent, 2002).

Residents in rural areas also tend to have lower levels of education. Research has shown the variation in education across degrees of rurality to be an important correlate of poorer health (Tremblay et al., 2002), and increased mortality—both 'treatable' and 'preventable' mortality—in rural areas (Subedi et al., 2019).

Income is a key factor in health for many, despite the so-called 'universal' health care available in Canada. Those with higher income tend to have better health (Debopadhaya et al., 2021; Frohlich et al., 2006; Subedi et al., 2019; Vafaei et al., 2010). Rural residents, as a whole, tend to have lower incomes than their urban counterparts (Bollman, 2022 Tremblay et al., 2002; Williams & Kulig, 2012). Income has even more of an impact on health status in the US, given the relationship between income and access to health insurance (Subedi et al., 2019).

Another key socio-demographic factor, with wide ranging implications is the concentration of Indigenous[2] populations in many rural areas of Canada (Bollman & Looker, 2020; Looker & Bollman, 2020; Williams & Kulig, 2012). See also

[2] Many of the research studies reviewed use the term 'Aboriginal'. We use 'Indigenous peoples' throughout this paper, except where a data source which we analyse (the Canadian Community Health Survey) asks about those who identify as "Aboriginal". In that chart (Figure, below) we report the term used in the survey.

Subedi et al. (2019) who document not only the higher proportion of Indigenous peoples in rural communities, but also the fact that what they call 'avoidable mortality' is higher in both First Nations and Inuit communities. This finding is consistent with that reported by Lavergne & Kephart (2012) that the higher the percent of Indigenous peoples in an area, the poorer the health. Smith et al. (2008) attribute similar patterns to the marginalization of indigenous peoples in Canada. As Frohlich et al. (2006) phrase it: "arguably the most egregious health disparities in Canada are those existing between Aboriginals and the rest of the Canadian population" (p. 132). These disparities extend to equitable access to health care facilities (Schuurman, 2009; Tremblay et al., 2002).

In terms of underlying health conditions, obesity and smoking are two health risk factors that are frequently shown to have higher incidence in rural areas (Vafaei et al., 2010). And, obesity has been linked to poorer health outcomes (Tremblay et al., 2002).

Some recent research has highlighted the ways that obesity, in addition to contributing to other health risks, has a direct impact on vulnerability to COVID-19.

> Obesity results in fat in the abdomen pushing up on the diaphragm. This can cause restricted airflow to the lungs which then results in shortness of breath or difficulty breathing. Contracting COVID-19 could make breathing even more difficult. The blood of people with obesity also tends to clot more, specifically in the lungs. Overall, the immune systems in people with obesity are not as strong. As BMI (Body Mass Index) increases, the risk of severe illness or death from COVID-19 also increases. (Centers for Disease Control and Prevention, n.d.)

The data on the impact of smoking on COVID-19 is less clear. However, there is some suggestion from the World Health Organization that smoking can increase the severity of the response if one contracts COVID-19. (World Health Organization, 2020). Smoking is, of course, implicated in respiratory illnesses such as asthma and chronic obstructive pulmonary disorder (COPD). There is a considerable research base documenting that smoking is more prevalent in rural areas (Debopadhaya et al., 2021; Eberhardt & Pamuk, 2004; Mitura & Bollman, 2003; Tremblay et al., 2002; Vafaei et al., 2010).

There are a number of other underlying conditions that have been shown to be associated with living in rural areas and are seen as underlying health factors that increase the risk of severe illness from COVID-19. These factors include: (a) diabetes (DesMeules & Pong, 2006; Eberhardt & Pamuk, 2004; Frohlich et al., 2006; Dobis & McGranahan, 2021; Subedi et al., 2019), (b) COPD (Eberhardt & Pamuk, 2004; Subedi et al., 2019), (c) asthma (Subedi et al., 2019), and (d) cancer (Eberhardt & Pamuk, 2004). However, note the caution made by Subedi et al. (2019) that "despite the tremendous amount of ongoing research, the mechanism of urban-rural health disparities is not fully understood in Canada" (p. 3).

These underlying health conditions have been tied to pre-pandemic reports of higher rates of mortality in rural as compared to urban areas. DesMeules & Pong (2006)

talk about a 'clear gradient in mortality' from urban to rural.[3] These higher rates are, according to Subedi et al. (2019), due to both geographic remoteness and the higher mortality rates in Indigenous peoples, who are more concentrated in rural and remote areas (Koifman et al., 2016). Specifically in terms of mortality from COVID-19 in the United States, Dobis and McGranahan (2021) report higher deaths per infection in rural areas, thanks in part to the older age of those living in rural areas and the higher rates of underlying medical conditions that make one susceptible to serious outcomes from the virus.

This 'mortality gradient' from urban to rural may reflect a similar gradient in underlying health conditions. Researchers have also explored rural–urban differences in access to health care resources, which obviously can have an impact on severity of outcomes, including death. One issue that has received a lot of attention is access to a family physician, for both diagnosis and care. Several studies[4] document that rural areas have a harder time attracting and retaining both family physicians and specialists. As Schuurman (2009) notes: "Poorer rural health outcomes have been attributed to the relative inaccessibility of quality primary health care services and health resources for rural Canadians" (pp. 58–59). However, the evidence is not straightforward. Pitblado et al. (2000) finds a fairly even distribution of heath care resources across the rural-urban spectrum, and Harrington et al. (2013) reports urban areas having more difficulty accessing specialists.

So despite some variation, overall, the existing literature on rural-urban differences in health shows a pattern of rural disadvantage. Rural areas are seen as having higher proportions of individuals with socio-economic characteristics associated with poorer health—being older, having lower levels of income, having lower levels of education. Rural areas have also been found to have higher proportions of individuals with underlying health conditions that would make them more vulnerable to serious illness from COVID-19, specifically: obesity, smoking, diabetes, COPD, asthma, and cancer. These results would suggest that, if they contract COVID-19, individuals living in rural areas would be more likely than others to develop serious illness from the disease, and thus have higher mortality rates.

The questions addressed in this paper are: which of the factors that are seen as contributing to (a) *contracting* COVID-19 and (b) *developing serious illness leading to death* from COVID-19, differ based on the rurality of one's location, according to recent data. Further, have these—or other—factors lead to higher rates of infection from COVID-19 and/or higher rates of death from the pandemic?

## 2.0 Data Sources

There are two key sources of data used in the analyses in this paper. One is the published information on COVID-19 cases and deaths in the different health regions within the ten provinces and three territories in Canada[5]. The data include the

[3] On the other hand, Pampalon et al. (2010) find higher rates of mortality in large CMAs.

[4] These studies include: Bollman, forthcoming; Fleet et al., 2018; Dobis & McGranahan, 2021; Moss et al., 2012; Ng et al., 1999; Pitblado & Pong, 1999; Ramsey & Beesley, 2006; Tholl, 2001. Pong et al. (2012) find no rural-urban differences in use of family physicians, but less use of specialists in rural areas.

[5] Most of the data on COVID-19 cases and death were obtained from the COVID-19 Canada Open Data Working Group (CCODWG) site https://github.com/ccodwg/Covid19Canada. These data include those living on First Nations reserves, a group that is excluded from the other data source, described below. The Open Data Working Group uses data from the health regions in each province,

*cumulative number of cases* of COVID-19, and the *cumulative number of deaths* from COVID-19 in each health region, as of May 18, 2021, as well as the relevant population size of the health region. Saskatchewan recently changed its health region boundaries so information on those boundaries and that classification of the health regions by rurality, was based on data from the government of Saskatchewan's website. Information on cumulative number of cases of COVID-19 in BC to May 18, 2021 was obtained from the government of British Columbia's website; data on deaths from COVID-19 in BC were obtained directly from Statistics Canada and BC Health.

The second data source is the Canadian Community Health Survey (CCHS), public use micro-data file for 2015–2016 and 2017–2018, which provides anonymized data at the individual level for those within each of these health regions[6]. This survey, conducted by Statistics Canada, sampled households within each health region in the provinces and territories, and used relevant imputation and weighting procedures to ensure that the data provide an accurate reflection of the patterns at the national, provincial, and territorial and sub-provincial levels. As we saw, many of the earlier analyses of rural–urban differences in health status draw on one or more iterations of the CCHS. Given the wealth of information contained in the CCHS, it is not surprising that a number of analyses examine the impact of rural location on health using that data source[7].

Information from the 2016 census on the distribution of the population in each health region, allowed us to classify each health region into one of three categories of "rurality", described below. The 2016 census provides details on the classification[8] of each *census sub-division* as a part of a: census metropolitan area (CMA); census agglomeration (CA); 'strong', 'moderate', 'weak' or 'no' metropolitan influenced zone (MIZ), or the non-CA areas of the Territories.

Each health region within each of the provinces was classified as either: (a) metro—CMA; (b) intermediate—CAs plus strong MIZ; or (c) rural—moderate, weak and no MIZ. Each of the Territories had only one health region; Yukon is classified as 'intermediate', given that Whitehorse is a CA; the Northwest Territories and Nunavut are 'rural', as more than 50% of their population lives outside a CA. The classification of health regions was based on *which of these three types of area*

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as reported by those provinces. Each province organizes communities into health regions in different ways, which creates challenges for comparing across provinces.

[6] The CCHS covers: "the population 12 years of age and over living in the ten provinces and the three territories. Excluded from the survey's coverage are: persons living on reserves and other Aboriginal settlements in the provinces; full-time members of the Canadian Forces; the institutionalized population, children aged 12–17 that are living in foster care, and persons living in the Quebec health regions of Région du Nunavik and Région des Terres-Cries-de-la-Baie-James. Altogether, these exclusions represent less than 3% of the Canadian population aged 12 and over." The exclusion of those living on First Nations Reserves may have an impact on some key rural-urban differences, especially in certain provinces. For details see:
https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3226

7 Analyses of the CCHS cited in this paper include: Harrington et al., 2013; Lavergne & Kephart, 2012; Mitura and Bollman, 2003; Pampalon et al., 2010; Sibley & Weiner, 2011; Tremblay et al., 2002 and Vafaei et al., 2010. The CCHS is conducted every year; these analyses are not necessarily based on the same sample. However, the sampling frame and questions used are consistent across cohorts, so finding similar patterns of results in different analysis is to be expected.

[8] The methodology for assigning each census sub-division to each category of Statistics Canada's Statistical Area Classification (i.e., CMA, CA and MIZ) is documented at
https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=314312#:~:text=Status%3A%20This%20standard%20was%20approved,and%20census%20metropolitan%20influenced%20zones

*contained the highest percentage of the population* in the health region. The list of health regions by rurality code is found in the Appendix to this paper.

It is important to note the limitations of the data being examined. The available data are limited to data for health regions. As indicated, we have classified each of the health regions in Canada as metro, intermediate, or rural. It is very important to note that this is a rough measure of rurality and that, within a particular health region, there may be communities–census sub-divisions that are rural as well as some which are urban by other, more precise definitions.

A recent analysis by the Royal Society of Canada (Moriarty et al., 2021) suggests that the mortality due to COVID-19 may be seriously underestimated, since many deaths outside long-term care facilities that, in fact, involved COVID-19 were not classified as being due to the virus, but rather attributed to another comorbidity. They suggest that this underreporting is likely highest in low-income, high-density, racialized neighbourhoods, including those with high concentrations of recent immigrants. This caveat should be kept in mind when considered the data on deaths due to COVID-19, reported below.

It is also very important to highlight the fact that the CCHS does not include those living on First Nations' reserves, due to the constraints on Statistics Canada in terms of distribution of surveys to those reserves. Since many First Nations' reserves are in rural areas, especially in some provinces, this fact is an important caveat to the findings. The CCHS does include Indigenous peoples who do not live on a reserve.

In the CCHS, the following socio-demographic measures were examined: age, income, highest level of education, and self-reported 'Aboriginal'[9] identity. Health measures in the CCHS examined by rurality of health region were (a) asthma, (b) cancer, (c) heart disease, (d) chronic obstructive pulmonary disease (COPD), (e) effects of a stroke, (f) high blood pressure, (g) whether one never smoked, and (h) whether one reported that they smoke daily.

## 3.0 Results—COVID-19 Rates by Rurality.

We examined the published data on cumulative cases of COVID-19 by health region. This information was accessed on May 21, and included data to May 18, 2021. Any COVID-19 related cases or deaths[10] since that date are not included in the tables or charts, below.

As indicated, above, there are some reasons to expect rates of contracting COVID-19 to be higher in urban areas, and other reasons why one might expect them to be higher in more rural communities. What has actually happened?

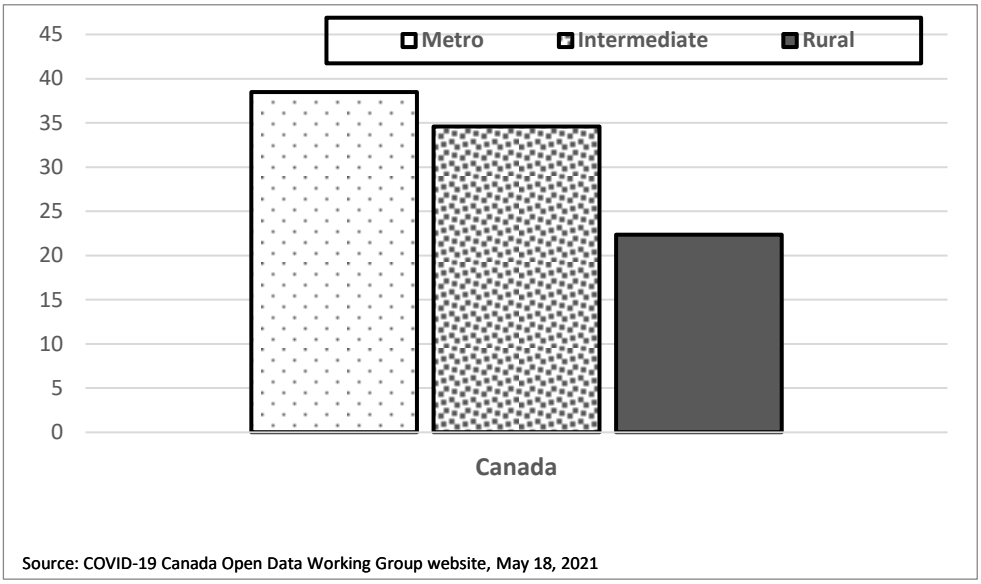
As shown in Figure 1, at the Canada-wide level, it is clear that those living in rural health regions are *less* likely to contract COVID-19 than those in more metro health regions. The cumulative rates of reported cases of COVID-19 were: Metro health regions: 38.5/1,000; Intermediate: 34.6/1,000 and Rural: 22.4/1,000. So, in

9 The term used in the CCHS was "Aboriginal identity", so that is the term used in this part of the analysis.

[10] Deaths will, of necessity, lag behind case numbers. It is important to keep this reality in mind when interpreting the patterns presented here, especially in those areas—such as Manitoba—which were undergoing an increase in COVID-19 cases in the third week of May 2021. In those areas, the rate of deaths from COVID-19 has likely increased since the data were accessed. Also, the spike in cases in the Yukon that took place in June 2021 will not appear in the data in this analysis.

terms of becoming infected with COVID-19, the high density in metro areas seems to be a critical factor.[11]

*Figure 1*. Cumulative cases of COVID-19 per thousand population (all ages) of COVID-19, Canada, as of May 18, 2021.



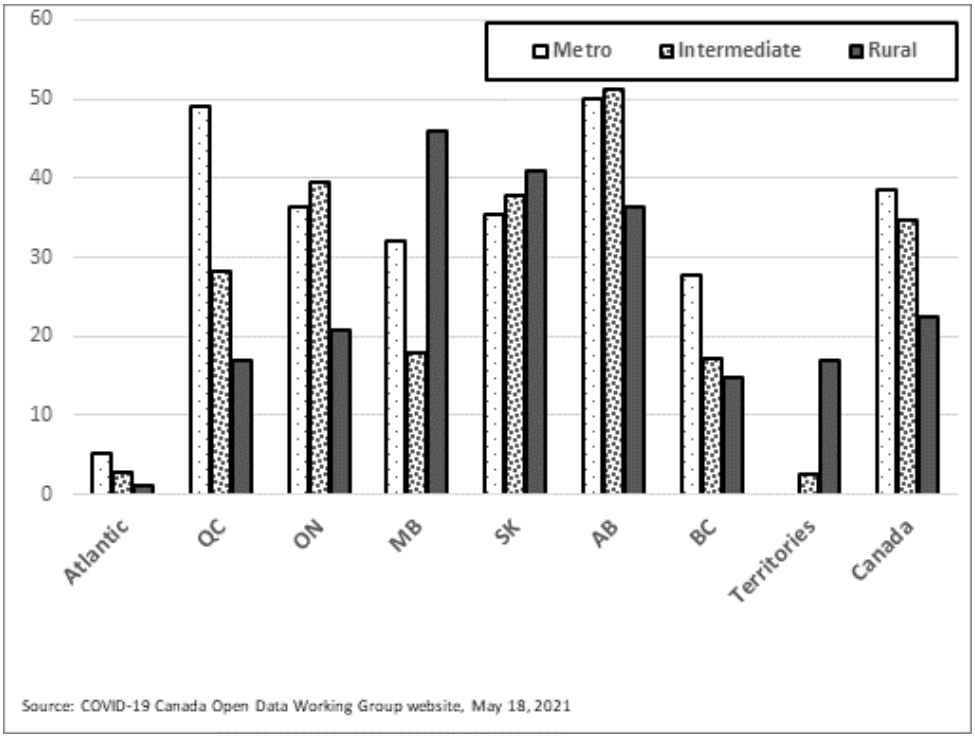

That said, the impact of living in a rural versus a metro environment is not consistent across the country, as Figure 2 shows. Specifically, in the Territories, Saskatchewan and especially in Manitoba, rural health regions had higher rates of COVID-19 infections than was true in other types of health regions. This pattern is an important exception to the overall pattern. Further investigation, beyond that possible with the data available for this paper, may be warranted. It may well be that the higher rates in these areas of Canada reflects the complex vulnerabilities of Indigenous peoples that influence their rates of contracting and dying from COVID-19[12]. Indigenous peoples make up a higher proportion[13] of those in the Territories, and in the non-metro areas Manitoba and Saskatchewan than in other areas of Canada.

[11] Further, if the recent Royal Society of Canada report (Moriarty et al., 2021) is correct about the underreporting of COVID-19 cases being more pronounced in high density, multi-generation families, especially those of recent immigrants, these households tend to be more concentrated in large urban centers. That is, a more accurate reporting of the cases of infection from this virus would exacerbate the rural-urban difference reported in Figure.

[12] According to recent Government of Canada published data, the rate of reported active cases of COVID-19 in First Nations people living on a reserve is currently 188% of the rate for the general Canadian population. (https://www.sac-isc.gc.ca/eng/1598625105013/1598625167707)

[13] Overall, 10% of Canadians living in non-metro areas report an "Aboriginal identity" (the words used in the Census of Population, which was the source of this information). In Saskatchewan the equivalent proportion is 22%, 27% in Manitoba, 23% in the Yukon, 51% in the Northwest Territories and 66% in Nunavut (Bollman and Looker, 2020, slide 430).

*Figure 2*. Cumulative cases of COVID-19 per thousand population (all ages) of COVID-19, by province, as of May 18, 2021.




It is interesting that the pattern of COVID-19 cases by rurality of health regions is so different comparing the three most populous provinces: BC, Quebec, and Ontario. The pattern in BC parallels that for Canada as a whole: the more rural, the lower the rates of COVID-19 cases per thousand. With much lower levels, the same pattern is seen in the Atlantic[14] region. In Ontario, those in the middle range of population density, (i.e., those in the intermediate health regions) have a slightly higher rate than those in metro health regions. A similar pattern is evident in Alberta. In Quebec[15], the metro–rural gradient seen at the Canada level is even more pronounced, with the metro rates being very high—49 per thousand—and those for the rural health regions very low—17 per thousand.

Nonetheless, the key takeaway from these numbers seems to be that, overall, COVID-19 rates are higher in high density metropolitan areas than in lower density rural health regions of Canada, with some important exceptions.

### *3.1 Risk of Serious Illness—the Role of Underlying Health Conditions*

There are a number of underlying health conditions that have been found to make an individual more susceptible to serious illness, hospitalization and death, should

[14] Rates are reported for the four Atlantic provinces, and for the three Territories as the case counts in the individual provinces and Territories are too low to discern a pattern. Each Territory is one health region; Yukon is classified as ‘intermediate’; Northwest Territories and Nunavut are ‘rural’.

[15] The report of the Royal Society of Canada (Moriarty et al., 2021) sees Quebec as having conducted more testing and having fairly accurate reports of the number of cases and deaths due to COVID-19. Note Quebec’s steep rural–metro gradient in cases in Figure.

they contract COVID-19. Data from the Canadian Community Health Survey[16] (CCHS) allow us to examine the distribution of these underlying conditions in the health regions in the different provinces in Canada.

We will look at some of the underlying *demographic differences* between rural and urban areas that might have an impact on vulnerability to severe illness and mortality from COVID-19. As we saw in the review of the literature there are some fairly consistent demographic differences in the characteristics of the populations—the social determinants of health—in rural as compared to urban areas, many of which have been linked to susceptibility to serious outcomes from COVID-19. These differences include: (a) age distribution, (b) differences in educational levels, (c) income levels, and (d) the proportion of the population with an 'Aboriginal identity'.

Figure 3 shows the expected pattern of a higher proportion of those surveyed by the CCHS[17] being in the older age groups in rural health regions as compared to metro health regions. More of those in rural—and those in the intermediate health regions—are in the 50–64 age range, and over 65 years of age. A higher proportion of those in metro health regions are in the age range 20–34 or 35–49 years of age. These data repeat what is known from other sources–more of those living in rural areas of Canada are older, compared to the metro areas; more of those in metro areas fall into the young age groups. And older individuals have been shown to be more susceptible to serious outcomes from COVID-19, as is reflected in the priority given to older age groups for vaccines.

Figure 4 shows the distribution of the population, by rurality of the health regions, and by the household[18] income reported by the individuals in the CCHS. As one would expect from other existing data sources, fewer of those living in the more rural areas, compared to those in metro areas, reside in households with high incomes—in this case, over $80,000 a year household income. More of those in metro health regions report this level of household income. Given the association between low income and susceptibility to serious outcomes from COVID-19 and other diseases, the pattern here suggests higher susceptibility to these outcomes in rural areas.

In a similar vein, Figure 5 shows the relationship of educational level by the rurality of one's health region. Again, the pattern is: the more rural the area, the lower the proportion with 'high socio-economic status', in this case, as measured by education. More of those—12 years of age and older—in rural health regions have less than a high school education, while more of those in metro regions have pursued some post-secondary education beyond high school. To the extent that education level is linked to outcomes from COVID-19, these results would suggest rural individuals are more at risk.

[16] Note that the CCHS excludes those in the Territories and those living on First Nations Reserves, so the base population numbers are not the same as those in Figure.

[17] Note that the CCHS is restricted to those 12 years of age and older.

[18] The charts for income and education are for information from individuals surveyed in the CCHS on the household in which the survey participant lives. The logic is that one's socio-economic status—as measured by income and education—tends to reflect the status of the household. The pattern of the rural–metro differences in the data are the same regardless of whether one uses the individual's reports of their own or their household education and income.

*Figure 3.* Distribution of population by age and rurality of health regions, Canada, CCHS.

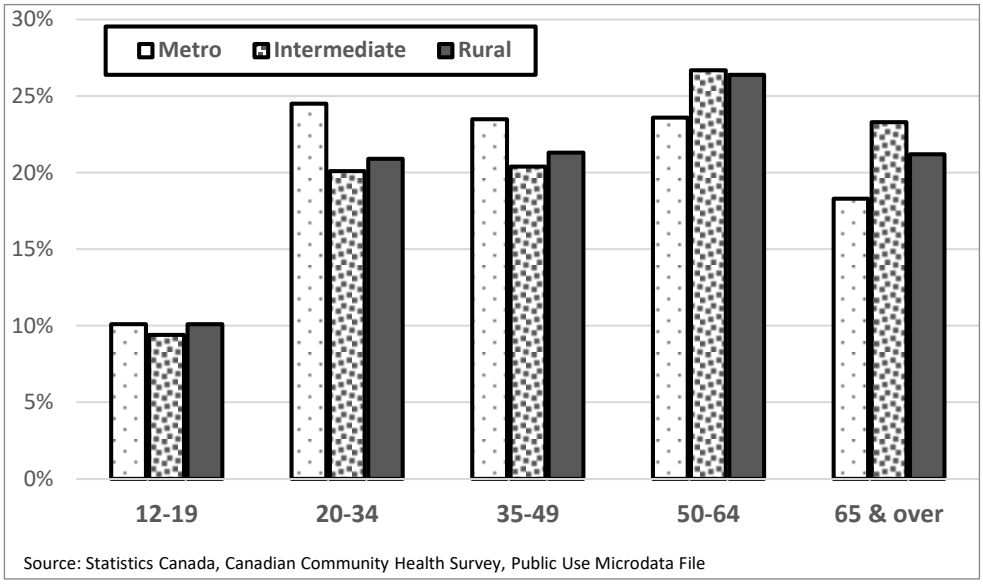



*Figure 4.* Distribution of household income by rurality of health regions, Canada, CCHS.

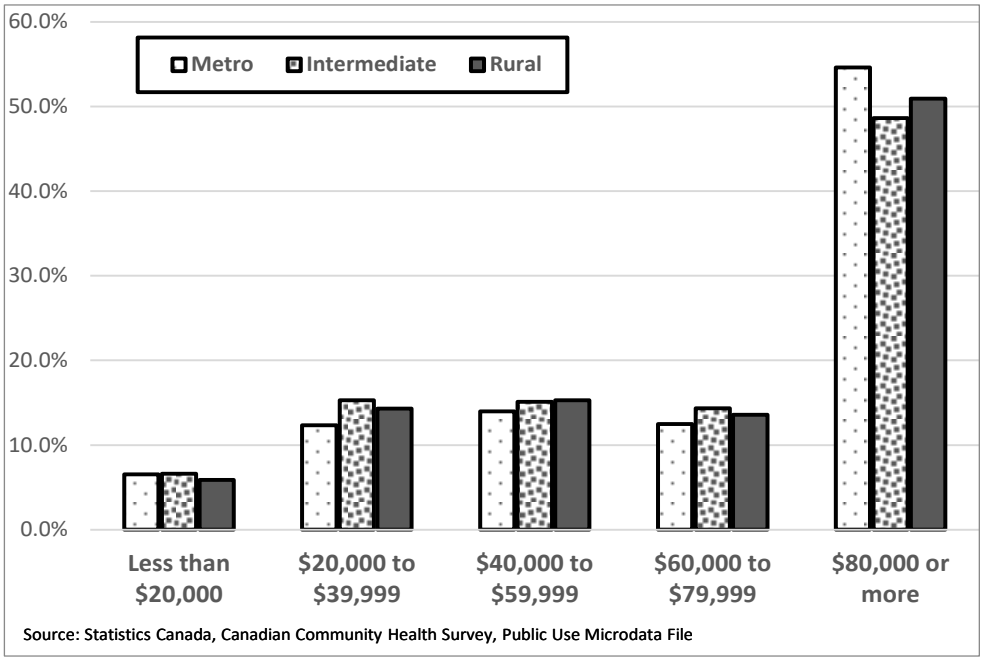
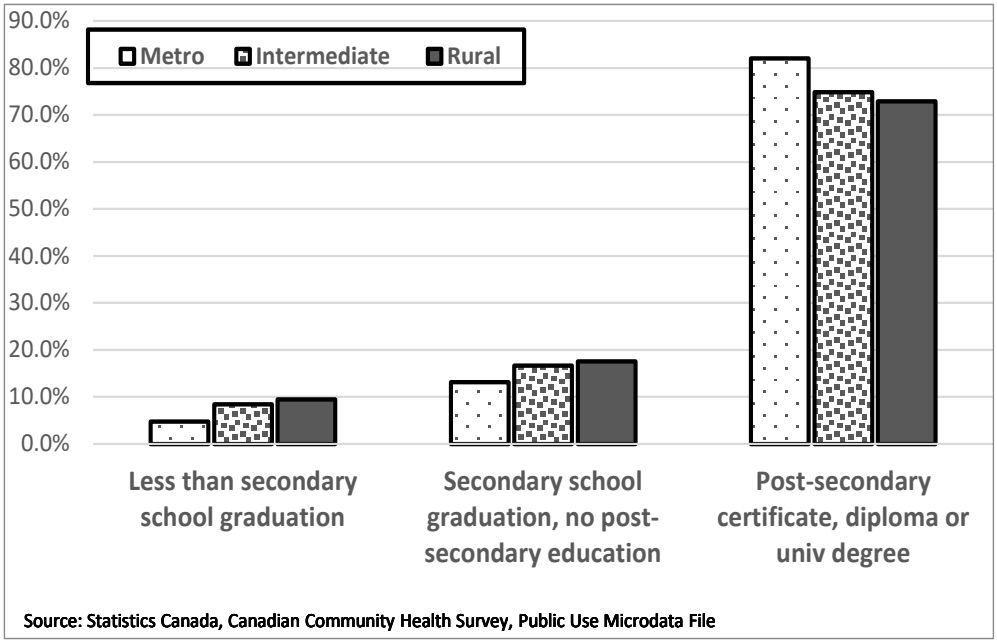


*Figure 5*. Distribution of reported 'highest level of education' in the household by rurality of health regions, Canada, CCHS.




Keeping in mind that the CCHS data file used in this part of the analysis does not include those living on First Nations' Reserves, we next look at the distribution, by rurality of the health region, of those who identify as having an 'Aboriginal identity'. This information is important because of the evidence reported in the review of the literature that Indigenous peoples are more vulnerable to various health risks. Figure 6 shows the clear pattern that more of those in rural health regions report an 'Aboriginal identity'.

In sum, this review of demographic differences by rurality of one's health region show a consistent pattern. Those factors that tend to be associated with serious illness—older age, low income, low education and having an 'Aboriginal identity'—are more prevalent in rural areas.

However, it is not simply demography, per se, that affects one's susceptibility to severe outcomes from COVID-19 and other illnesses, but rather the underlying health conditions that tend to be associated with those demographic characteristics. We know that certain underlying health conditions make one more vulnerable to severe complications or death if one contracts COVID-19. The conditions for which we have information in the CCHS include: (a) asthma, (b) chronic obstructive pulmonary disease (COPD), (c) high blood pressure, (d) heart disease, (e) diabetes, (f) cancer, (g) effects of a stroke, (h) obesity, and (i) smoking. We will examine the rural–urban distribution, by health region, of each of these conditions. As well, a composite index will be calculated of how many of these underlying conditions are present in an individual, and the results compiled by rurality of health region.

We look at how rurality of a health region is related to the individual, specific health conditions that are known to increase susceptibility to severe illness from COVID-19. Figure 7 gives the results.

*Figure 6*. Distribution of those reporting an 'Aboriginal identity' by rurality of health regions, Canada, CCHS.

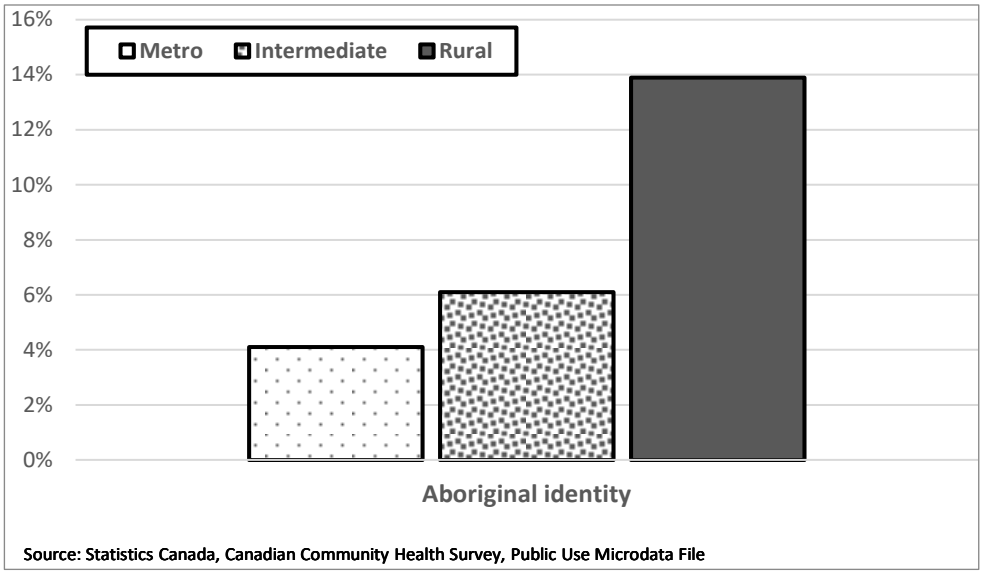
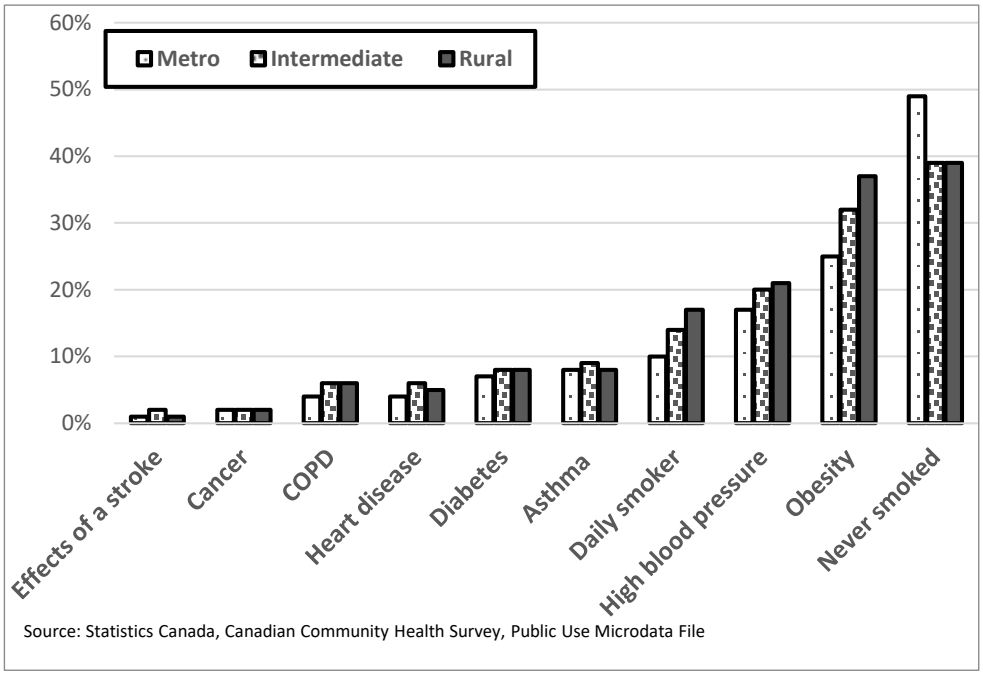



*Figure 7*. Proportion reporting specific underlying health conditions, by rurality of health regions, Canada, CCHS.




For all the specific conditions, except for cancer and suffering from the effects of a stroke, there is a difference in the proportions reporting each specific condition, by rurality of the health region. And in every case, the pattern is that those in metro areas have a lower proportion of individuals reporting the specific medical condition than is true in other health regions. The differences are often small: 2 percentage points for COPD, only 1 percentage point for diabetes, heart disease, or asthma. The

percentage point spread is somewhat higher for having high blood pressure. Obesity levels, based on self-reported height and weight calculations of BMI show a dramatic gradient by rurality. Only 25% of those in metro health regions are obese by this measure, compared to 32% of those in intermediate health regions and 37% in rural health regions. A similar gradient is seen in the two complementary measures of smoking behaviour: reporting that one currently smokes daily and reporting that one has never smoked. The reverse of this last measure ('never smoked'[19]) gives the health risk of 'ever smoked'.

Overall, it is interesting that the levels of these underlying risk factors are so similar in rural health regions and in those categorized as intermediate. One might have expected that the intermediate health regions would be more similar to metro health regions in these reported health factors. Intermediate health regions have more of their population in a census agglomeration (CA) or in 'strong Miz'. Keep in mind that census agglomerations (CAs) can be up to 100,000 in population. Those areas classified as 'strong MIZ' are those in which 30% or more of the employed residents commute to a CMA or a CA. In other words, they are within fairly close commuting distance of a more metro centre. So, one might expect a pattern of health risk in these larger towns and metro adjacent areas to be similar to those in Metro areas, but that is not the pattern we see here.

While the percentage point difference by rurality in most of these specific underlying risk conditions is in many cases quite small, it is statistically significant. Further, as Figure 8 shows, there is an important difference in the *number* of underlying health conditions reported by a given individual, based on the rurality of the health region in which they live. Over half (53%) of those in metro health regions report none of the nine health conditions considered here. This proportion compares to 44% in intermediate and 41% in more rural health regions. Again, note that intermediate regions are similar to rural regions, not metro ones. About a third of those in all health regions report at least one of these underlying health conditions. At the other end of the spectrum, the rates of having two or more of these risk factors are: 18% in metro, 24% in intermediate and 26% in rural health regions. The differences are not large, but they are consistent—rural is more vulnerable.

So, in terms of both the specific health conditions and the number of such underlying health conditions, residents of rural health regions seem to have more conditions which put them at risk of complications, severe illness, and death from COVID-19. Given these results one would expect both higher hospitalizations and higher rates of death in rural health regions, compared to the other types of health regions.

But what of access to care? Perhaps the rurality of one's community has an impact on access to the health care they need to deal effectively with both underlying health conditions, and with COVID-19 infections. Access to care, by type of health region, could mitigate some of the potential disadvantages that certain residents face due to the higher rates of risk factors, discussed above.

The CCHS has some information on reported access to health care in the different health regions. Figure 9 gives the relevant information.

[19] The CCHS reports those who 'never smoked' which is why that is the information presented here.

*Figure 8*. Proportion reporting, two, one, or no underlying health conditions, by rurality of health regions, Canada, CCHS.

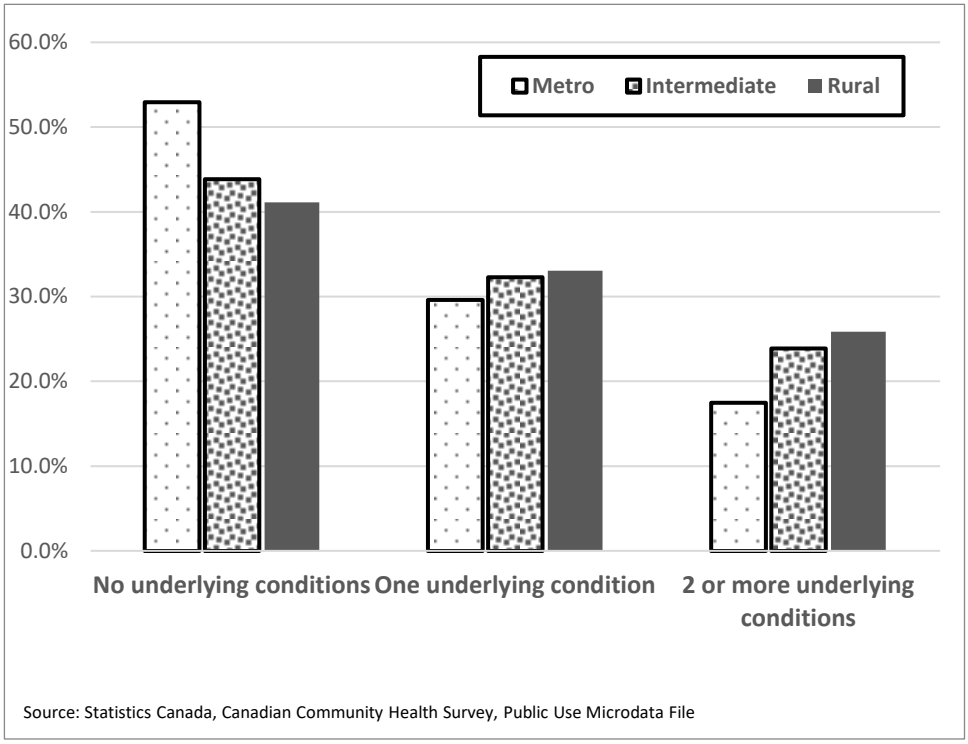



*Figure 9*. Proportion reporting lack of access to a health care provider, by rurality of health regions, Canada, CCHS.

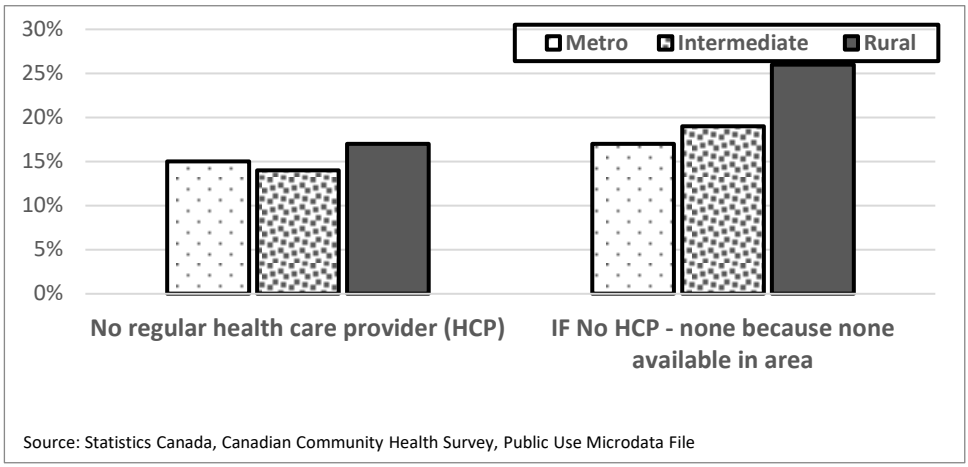
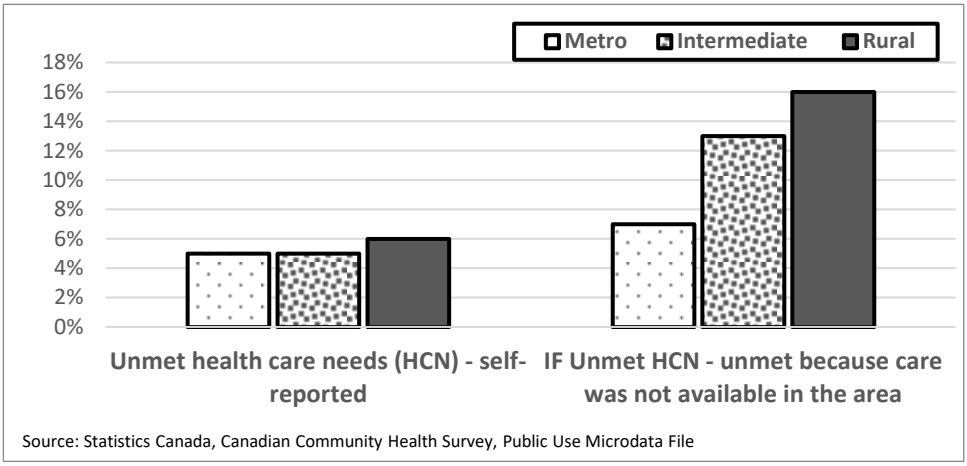



Figure 9 shows the reported rates of access to a regular health care provider. Here we see that, overall, about 15% of those in the CCHS report they do not have a regular health care provider; 85% do have such a provider. Given the media coverage of the difficulty of attracting physicians to rural areas, it is perhaps not surprising that the percentage reporting 'no regular health care provider' is somewhat higher in rural health regions: 17%, compared to 14% in intermediate health regions and 15% in metro health regions, but this difference is very small. The next set of columns show that, *among those who say they have no regular health*

*care provider*, rural residents are more likely than others to say this lack is due to none being available in the area.

In Figure 10 we see the level of self-reported 'unmet health care needs', by rurality of the health region. Again, there is not much difference in the low percentages in rural as compared to other health regions (6% versus 5%) reporting they feel they have 'unmet health care needs'. However, among this minority who *do* say they have unmet needs, more of those living in rural health regions say their health care needs are unmet because the needed care was not available in the area. About one in six (16%) of those in rural health regions say their unmet health care needs was due to unavailability of the needed care in their area. This compares to 13% in intermediate, and only 7% in metro health regions.

*Figure 10.* Proportion reporting unmet health care needs, by rurality of health regions, Canada, CCHS.




## *3.2 Overview of Results on Vulnerability by Rurality of Health Region*

To summarize the findings to this point. Based on results from the CCHS, residents of rural health regions are more vulnerable than those living in other health regions in Canada to serious illness from COVID-19 insofar as they:

- are older;
- are more likely to have low incomes;
- are more likely to have lower levels of education;
- are more likely to have an 'Aboriginal identity';
- have higher rates of several underlying medical conditions, that are known to make one more susceptible to serious illness, hospitalization, and death from COVID-19, including higher rates of obesity and smoking;
- are more likely to be without a regular health care provider because none is available in their area; and
- are more likely to report unmet health care needs because the care is not available in their area.

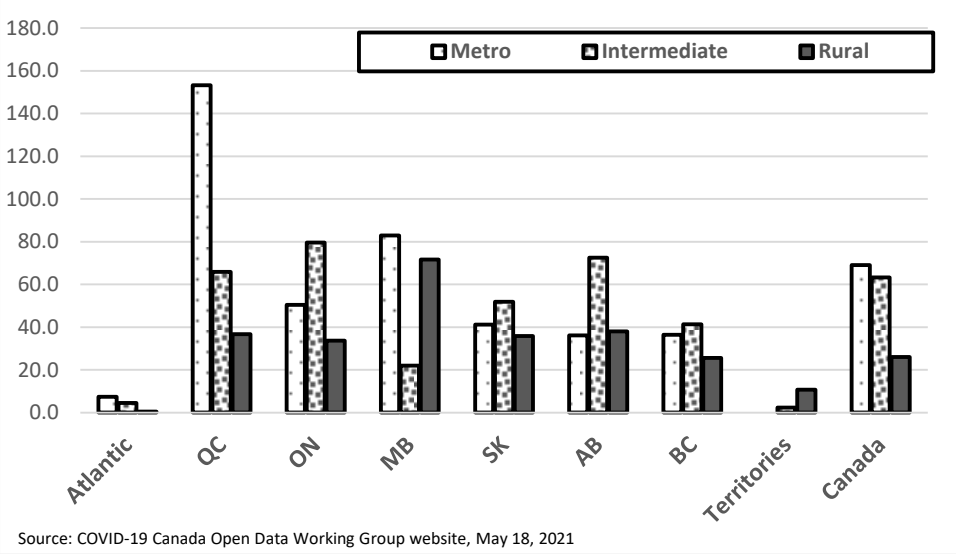
## *3.3 Outcomes of Contracting COVID-19*

We saw, in Figure 1 and Figure 2 above, that overall, metro health regions had higher rates of cases of COVID-19 than the other two types of health regions. This pattern

varied by province; in Manitoba and Saskatchewan, the rates per thousand of COVID-19 were higher in rural health regions.

Ideally, we would have comparable rates of hospitalizations from COVID-19 by health region. However, those data were not available from the accessed sources. What *is* available are cumulative rates of death[20] from COVID-19, by health region (see Figure 11).

*Figure 11*. Cumulative number of deaths per thousand population from COVID-19, Canada, Provinces and Territories.




Overall, the pattern of rates of *deaths* from COVID-19 for Canada parallels that for *cases* of COVID-19. There is a higher rate of deaths in metro health regions, slightly lower rates in the intermediate health regions, and lower still in the rural health regions. It is interesting that, in none of the provinces, are the death rates per thousand population from COVID-19 highest[21] in the rural health regions of the province or area. This pattern is there despite the fact that the cases per thousand were higher in rural compared to metro and intermediate areas in Manitoba and Saskatchewan (see Figure 2).

Further, the higher levels of vulnerability and underlying health conditions in rural regions, reported above, do *not* seem to have led to higher rates of COVID-19 deaths in these rural areas.

However, this finding may not be surprising, given the pattern of higher cases in more metro areas in most areas of the country. Figure 12 allows us to get a clearer picture of the vulnerability of the different types of health regions[22], by examining *deaths per case* of COVID-19.

[20] The reported number and rates of death need to take into account the caveat put forward by Moriarty et al. (2021).

[21] Note the interesting pattern in Manitoba where the intermediate health regions have the lowest rates of deaths per thousand. In Ontario and the other western provinces, the intermediate health regions, as a whole, have the highest death rates per thousand.

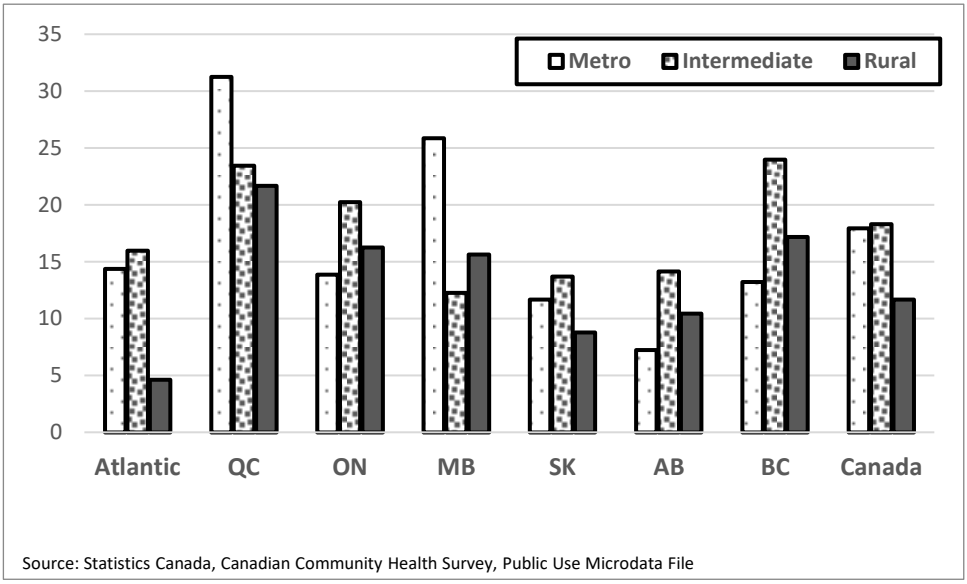
[22] There are too few cases of death from COVID-19 in the Territories to calculate meaningful rates.

Looking at the far right hand column in Figure 12, we see the pattern for Canada as a whole. There are *fewer* deaths per case in rural health regions than in either the intermediate regions or the metro health regions. This pattern holds despite the fact that, as we have seen, rural areas have higher rates of underlying demographic conditions and higher rates of underlying health conditions that make them vulnerable to more serious health outcomes from COVID-19 and other illnesses.

If all types of health regions had similar rates of death per case, we could surmise that the health care provisions in all areas was adequate to meet the challenges posed by the COVID-19 pandemic. However, as we know from news reports, hospitals in areas with high numbers of cases of COVID-19 were often stretched to the limit and beyond.

What Figure 12 documents is the grim reality that, even taking into account the relative number of cases in the different regions, in many areas[23] of the country, those living in large metropolitan areas were more likely than those in rural areas to die from COVID-19[24].

Figure 12. Deaths per thousand cases of COVID-19, by rurality of health regions, Canada and Provinces.




Looking at the intermediate health regions, we saw in Figure 1 that the rates of COVID-19 in these areas are between those for the other two regions but, overall, are closer to the pattern in metro health regions. In contrast, intermediate health regions were more like rural regions in the rates of underlying health conditions (Figure 7 and Figure 8). With important variation by province, intermediate regions are again similar to metro in both overall death rates from COVID-19, and deaths

[23] Metro health regions have higher deaths per thousand cases than rural health regions in the Atlantic provinces, as a group, in Quebec, Manitoba, Saskatchewan, and Canada as a whole. Rural rates are higher than metro rates in Ontario, Alberta, and BC. The rates in intermediate health regions, relative to the other two types of health region, varies considerably across the country.

[24] It is our understanding that those who die from COVID-19 are classified to the locale—and therefore the health region: metro, intermediate or rural—where they were living when they contracted COVID-19.

per case. More detailed analyses of the sources of the considerable variation in these patterns, by province, is beyond the scope of this paper, but is clearly warranted.

## 4.0 Discussion

This paper examines the impact of where one lives in Canada on the likelihood of contracting and of dying from COVID-19. Given the existing research that documents the vulnerability of those who live in rural areas, one might expect both higher rates of COVID-19 and higher rates of death from the disease, if one contracts it.

It is interesting and important that the clear findings are the reverse of this expectation. In fact, in Canada, those living in more metro health regions are more likely to contract COVID-19. This seems to be a case of higher density being a disadvantage.

This pattern exists despite the underlying socio-demographic risk factors—age, low income, low education, having an 'Aboriginal identity'—being higher in rural areas. And this pattern exists despite the prevalence of underlying health conditions—asthma, cancer, heart disease, chronic obstructive pulmonary disease (COPD), effects of a stroke, high blood pressure; being obese, and smoking—in rural areas.

As other research has documented, there are also more limitations in access to health care resources in rural areas. So, the data we present documents that those living in rural health regions are more likely than those in other health regions to have limited access to a personal health care provider and to report that they have unmet health care needs due to a lack of availability to needed resources.

Both the higher rates of underlying health conditions that tend to make one more vulnerable to serious illness from COVID-19, and the more limited access to health care in rural areas, would lead one to expect higher rates of death per case from this disease in rural areas. However, that is not the pattern found in Canada and in most provinces.

Dobis and McGranahan (2021) in the US *did* find higher rates of deaths per case in rural areas. The fact that the finding in Canada is that metro, not rural areas, have both higher rates of COVID-19 *and* higher rates of death per case of COVID-19 may reflect the wider access to health care services in Canada overall. Access to these health care services does not rely so much on access to private health care funding in Canada as it does for many Americans. If it is the case that access to health care is more universal in Canada, neither one's socio-economic status nor one's geographic location would have much impact on obtaining health care, when needed.

In any case, the results reported here, from official COVID-19 reporting sites, show that metro, not rural health regions are more vulnerable to COVID-19. They are more likely to contract the disease, likely due to the increased contact inherent in high density areas. They are more likely to die from COVID-19 if they contract it. It is not clear why this last pattern holds. It may be that hospitals in the very high-density areas of metro regions of many provinces became overwhelmed during the waves of the pandemic. Further, this pattern may well have changed as new waves of the pandemic are experienced across the country.

Nevertheless, the data presented here challenge the often cited message of 'rural vulnerability'. In the case of widespread and highly transmissible diseases such as COVID-19, the high density of metropolitan areas seems to make them more vulnerable.

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## Appendix

Listed below are all the health regions in Canada, as of May 2021, as designated by the province or territory.

Health regions were assigned to one of three classifications: (a) Metro, (b) Intermediate, or (c) Rural. This classification is based on whether the largest share of the population in the health region in 2019 resided in: CMAs (Metro); in CAs plus Strong MIZ (Intermediate); or in Moderate to no MIZ (Rural).

The population for these categories of Statistics Canada 'Statistical Area Classification' (i.e. CMA/CA/MIZ), as described at https://www.statcan.gc.ca/en/subjects/standard/sgc/2016/introduction, was published in Statistics Canada Table 105-0592.

## LIST OF HEALTH REGIONS BY RURALITY CODE, CASES AND DEATHS FROM COVID-19, AND 2019 POPULATION SIZE

| Province | Health Region Name | Health Region ID | Census Metropolitan Area | CAs + Strong MIZ | Moderate to No MIZ | Rurality Classification | COVID-19 Case Count | COVID-19 Cases per thousand | Deaths from COVID-19 | Deaths from COVID-19 per 100K | Deaths per case of COVID-19 | Total Population 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Percent of population | | | | | | | | | |
| NL | Eastern Regional Health Authority | 1011 | 66 | 10 | 25 | 1 | 1,024 | 3.3 | 5 | 1.6 | 4.9 | 310,426 |
| NL | Central Regional Health Authority | 1012 | 0 | 48 | 52 | 3 | 81 | 0.9 | 0 | 0.0 | 0.0 | 85,388 |
| NL | Western Regional Health Authority | 1013 | 0 | 43 | 57 | 3 | 91 | 1.2 | 1 | 1.4 | 11.0 | 73,072 |
| NL | Labrador-Grenfell Regional Health Authority | 1014 | 0 | 0 | 100 | 3 | 13 | 0.4 | 0 | 0.0 | 0.0 | 35,649 |
| PE | Prince Edward Island | 1100 | 0 | 78 | 22 | 2 | 194 | 1.4 | | 0.0 | 0.0 | 135,849 |
| NS | Zone 1 - Western | 1201 | 0 | 25 | 75 | 3 | 249 | 1.3 | 1 | 0.5 | 4.0 | 185,660 |
| NS | Zone 2 - Northern | 1202 | 0 | 79 | 21 | 2 | 240 | 1.6 | 1 | 0.7 | 4.2 | 145,940 |
| NS | Zone 3 - Eastern | 1203 | 0 | 62 | 38 | 2 | 387 | 2.8 | 5 | 3.6 | 12.9 | 138,177 |
| NS | Zone 4 - Central | 1204 | 95 | 4 | 1 | 1 | 4,041 | 9.1 | 65 | 14.6 | 16.1 | 444,740 |
| NB | Zone 1 (Moncton area) | 1301 | 70 | 17 | 13 | 1 | 420 | 1.9 | 5 | 2.3 | 11.9 | 217,155 |
| NB | Zone 2 (Saint John area) | 1302 | 74 | 0 | 26 | 1 | 290 | 1.9 | 8 | 5.4 | 27.6 | 149,412 |
| NB | Zone 3 (Fredericton area) | 1303 | 0 | 63 | 37 | 2 | 324 | 1.8 | 0 | 0.0 | 0.0 | 179,137 |
| NB | Zone 4 (Edmundston area) | 1304 | 0 | 62 | 38 | 2 | 750 | 16.5 | 25 | 55.1 | 33.3 | 45,390 |
| NB | Zone 5 (Campbellton area) | 1305 | 0 | 88 | 12 | 2 | 185 | 8.0 | 4 | 17.3 | 21.6 | 23,126 |
| NB | Zone 6 (Bathurst area) | 1306 | 0 | 55 | 45 | 2 | 80 | 1.1 | 0 | 0.0 | 0.0 | 70,761 |
| NB | Zone 7 (Miramichi area) | 1307 | 0 | 90 | 10 | 2 | 34 | 0.8 | 0 | 0.0 | 0.0 | 42,440 |
| QC | Région du Bas-Saint-Laurent | 2401 | 0 | 60 | 40 | 2 | 3,747 | 19.1 | 40 | 20.4 | 10.7 | 196,158 |
| QC | Région du Saguenay—Lac-Saint-Jean | 2402 | 58 | 27 | 15 | 1 | 10,677 | 38.6 | 269 | 97.4 | 25.2 | 276,281 |
| QC | Région de la Capitale-Nationale | 2403 | 88 | 6 | 6 | 1 | 32,266 | 46.0 | 1,102 | 157.3 | 34.2 | 700,684 |
| QC | Région de la Mauricie et du Centre-du-Québec | 2404 | 31 | 49 | 20 | 2 | 14,840 | 28.6 | 515 | 99.4 | 34.7 | 518,043 |
| QC | Région de l'Estrie | 2405 | 45 | 38 | 17 | 1 | 14,200 | 27.7 | 342 | 66.6 | 24.1 | 513,429 |
| QC | Région de Montréal | 2406 | 100 | 0 | 0 | 1 | 129,244 | 69.6 | 4,714 | 253.9 | 36.5 | 1,856,818 |
| QC | Région de l'Outaouais | 2407 | 87 | 3 | 10 | 1 | 11,883 | 29.0 | 208 | 50.8 | 17.5 | 409,421 |
| QC | Région de l'Abitibi-Témiscamingue | 2408 | 0 | 57 | 43 | 2 | 1,107 | 7.5 | 9 | 6.1 | 8.1 | 148,529 |
| QC | Région de la Côte-Nord | 2409 | 0 | 63 | 37 | 2 | 566 | 6.5 | 3 | 3.4 | 5.3 | 87,447 |
| QC | Région du Nord-du-Québec | 2410 | 0 | 0 | 100 | 3 | 102 | 7.0 | 0 | 0.0 | 0.0 | 14,642 |
| QC | Région de la Gaspésie—Îles-de-la-Madeleine | 2411 | 0 | 5 | 95 | 3 | 1,947 | 22.9 | 45 | 52.9 | 23.1 | 85,097 |
| QC | Région de la Chaudière-Appalaches | 2412 | 38 | 32 | 30 | 2 | 18,437 | 43.4 | 340 | 80.0 | 18.4 | 425,016 |
| QC | Région de Laval | 2413 | 100 | 0 | 0 | 1 | 30,818 | 70.3 | 907 | 206.9 | 29.4 | 438,320 |
| QC | Région de Lanaudière | 2414 | 64 | 30 | 6 | 1 | 23,563 | 53.0 | 512 | 115.1 | 21.7 | 444,734 |
| QC | Région des Laurentides | 2415 | 68 | 16 | 17 | 1 | 20,420 | 35.5 | 499 | 86.7 | 24.4 | 575,539 |
| QC | Région de la Montérégie | 2416 | 75 | 22 | 2 | 1 | 50,013 | 36.5 | 1,542 | 112.5 | 30.8 | 1,370,770 |
| QC | Région du Nunavik | 2417 | 0 | 0 | 100 | 3 | 47 | 3.4 | 0 | 0.0 | 0.0 | 13,849 |
| QC | Région des Terres-Cries-de-la-Baie-James | 2418 | 0 | 0 | 100 | 3 | 119 | 7.0 | 3 | 17.6 | 25.2 | 17,069 |

| Province | Health Region Name | Health Region ID | Census Metropolitan Area | CAs + Strong MIZ | Moderate to No MIZ | Rurality Classification | COVID-19 Case Count | COVID-19 Cases per thousand | Deaths from COVID-19 | Deaths from COVID-19 per 100K | Deaths per case of COVID-19 | Total Population 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Percent of population | | | | | | | | | |
| ON | The District of Algoma Health Unit | 3526 | 0 | 87 | 13 | 2 | 373 | 3.4 | 4 | 3.6 | 10.7 | 111,060 |
| ON | Brant County Health Unit | 3527 | 96 | 4 | 0 | 1 | 3,082 | 20.3 | 20 | 13.2 | 6.5 | 152,029 |
| ON | Durham Regional Health Unit | 3530 | 95 | 5 | 0 | 1 | 23,544 | 33.7 | 355 | 50.7 | 15.1 | 699,641 |
| ON | Grey Bruce Health Unit | 3533 | 0 | 35 | 65 | 3 | 1,304 | 8.4 | 0 | 0.0 | 0.0 | 154,672 |
| ON | Haldimand-Norfolk Health Unit | 3534 | 0 | 100 | 0 | 2 | 2,556 | 22.6 | 41 | 36.3 | 16.0 | 113,098 |
| ON | Haliburton, Kawartha, Pine Ridge District Health Unit | 3535 | 0 | 82 | 18 | 2 | 1,833 | 9.9 | 73 | 39.3 | 39.8 | 185,663 |
| ON | Halton Regional Health Unit | 3536 | 100 | 0 | 0 | 1 | 16,932 | 28.0 | 220 | 36.3 | 13.0 | 605,475 |
| ON | City of Hamilton Health Unit | 3537 | 100 | 0 | 0 | 1 | 18,525 | 32.1 | 374 | 64.9 | 20.2 | 576,272 |
| ON | Hastings and Prince Edward Counties Health Unit | 3538 | 64 | 29 | 6 | 1 | 1,071 | 7.4 | 10 | 6.9 | 9.3 | 144,779 |
| ON | Huron County Health Unit | 3539 | 0 | 0 | 100 | 3 | 1,732 | 12.7 | 55 | 40.2 | 31.8 | 136,672 |
| ON | Chatham-Kent Health Unit | 3540 | 0 | 100 | 0 | 2 | 1,841 | 17.5 | 13 | 12.3 | 7.1 | 105,303 |
| ON | Kingston, Frontenac and Lennox and Addington Health Unit | 3541 | 83 | 14 | 2 | 1 | 1,502 | 7.3 | 3 | 1.5 | 2.0 | 206,768 |
| ON | Lambton Health Unit | 3542 | 0 | 88 | 12 | 2 | 3,411 | 29.4 | 58 | 50.0 | 17.0 | 115,985 |
| ON | Leeds, Grenville and Lanark District Health Unit | 3543 | 10 | 72 | 18 | 2 | 1,708 | 11.1 | 60 | 39.1 | 35.1 | 153,598 |
| ON | Middlesex-London Health Unit | 3544 | 96 | 4 | 0 | 1 | 11,667 | 23.7 | 214 | 43.4 | 18.3 | 492,971 |
| ON | Niagara Regional Area Health Unit | 3546 | 97 | 3 | 0 | 1 | 15,290 | 33.9 | 401 | 88.9 | 26.2 | 450,816 |
| ON | North Bay Parry Sound District Health Unit | 3547 | 0 | 59 | 41 | 2 | 426 | 3.3 | 4 | 3.1 | 9.4 | 128,804 |
| ON | Northwestern Health Unit | 3549 | 0 | 20 | 80 | 3 | 1,038 | 13.9 | 7 | 9.4 | 6.7 | 74,771 |
| ON | City of Ottawa Health Unit | 3551 | 100 | 0 | 0 | 1 | 26,161 | 25.7 | 536 | 52.6 | 20.5 | 1,019,693 |
| ON | Peel Regional Health Unit | 3553 | 100 | 0 | 0 | 1 | 105,404 | 67.9 | 747 | 48.1 | 7.1 | 1,553,076 |
| ON | Peterborough County–City Health Unit | 3555 | 88 | 10 | 2 | 1 | 1,405 | 9.7 | 18 | 12.5 | 12.8 | 144,237 |
| ON | Porcupine Health Unit | 3556 | 0 | 50 | 50 | 2 | 887 | 9.8 | 26 | 28.7 | 29.3 | 90,540 |
| ON | Renfrew County and District Health Unit | 3557 | 0 | 72 | 28 | 2 | 675 | 6.3 | 7 | 6.6 | 10.4 | 106,578 |
| ON | The Eastern Ontario Health Unit | 3558 | 20 | 69 | 11 | 2 | 4,693 | 26.2 | 103 | 57.4 | 21.9 | 179,454 |
| ON | Simcoe Muskoka District Health Unit | 3560 | 49 | 39 | 12 | 1 | 11,446 | 20.4 | 241 | 42.9 | 21.1 | 562,142 |
| ON | Sudbury and District Health Unit | 3561 | 84 | 4 | 12 | 1 | 2,055 | 10.1 | 29 | 14.3 | 14.1 | 202,681 |
| ON | Thunder Bay District Health Unit | 3562 | 80 | 4 | 15 | 1 | 3,167 | 20.5 | 63 | 40.8 | 19.9 | 154,444 |
| ON | Timiskaming Health Unit | 3563 | 0 | 2 | 98 | 3 | 200 | 6.0 | 2 | 6.0 | 10.0 | 33,389 |
| ON | Waterloo Health Unit | 3565 | 98 | 2 | 0 | 1 | 15,364 | 26.9 | 254 | 44.5 | 16.5 | 571,232 |
| ON | Wellington-Dufferin-Guelph Health Unit | 3566 | 67 | 22 | 11 | 1 | 7,623 | 25.1 | 111 | 36.5 | 14.6 | 304,193 |
| ON | Windsor-Essex County Health Unit | 3568 | 83 | 17 | 0 | 1 | 16,149 | 46.3 | 421 | 120.7 | 26.1 | 348,836 |
| ON | York Regional Health Unit | 3570 | 100 | 0 | 0 | 1 | 50,593 | 42.1 | 649 | 54.0 | 12.8 | 1,200,761 |
| ON | Oxford Elgin St. Thomas Health Unit | 3575 | 28 | 72 | 0 | 2 | 3,675 | 17.6 | 79 | 37.8 | 21.5 | 209,238 |
| ON | City of Toronto Health Unit | 3595 | 100 | 0 | 0 | 1 | 162,311 | 54.3 | 3,276 | 109.7 | 20.2 | 2,987,513 |

| Province | Health Region Name | Health Region ID | Census Metropolitan Area | CAs + Strong MIZ | Moderate to No MIZ | Rurality Classification | COVID-19 Case Count | COVID-19 Cases per thousand | Deaths from COVID-19 | Deaths from COVID-19 per 100K | Deaths per case of COVID-19 | Total Population 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Percent of population | | | | | | | | | |
| MB | Winnipeg Regional Health Authority | 4601 | 100 | 0 | 0 | 1 | 26,660 | 33.8 | 704 | 89.4 | 26.4 | 787,724 |
| MB | Prairie Mountain Health | 4602 | 0 | 55 | 45 | 2 | 3,160 | 22.2 | 67 | 47.2 | 21.2 | 142,031 |
| MB | Interlake-Eastern Regional Health Authority | 4603 | 23 | 29 | 49 | 3 | 3,102 | 17.9 | 38 | 22.0 | 12.3 | 173,021 |
| MB | Northern Regional Health Authority | 4604 | 0 | 24 | 76 | 3 | 7,074 | 91.4 | 51 | 65.9 | 7.2 | 77,380 |
| MB | Southern Health—Santé Sud | 4605 | 18 | 63 | 18 | 2 | 5,917 | 28.7 | 152 | 73.8 | 25.7 | 205,885 |
| SK | Sun Country Regional Health Authority | 4701 | 0 | 52 | 48 | 2 | 2,156 | 22.1 | 16 | 16.4 | 7.4 | 97,493 |
| SK | Five Hills Regional Health Authority | 4702 | 0 | 71 | 29 | 2 | 732 | 20.1 | 5 | 13.7 | 6.8 | 36,454 |
| SK | Cypress Regional Health Authority | 4703 | 1 | 47 | 52 | 3 | 355 | 120.4 | 3 | 101.8 | 8.5 | 2,948 |
| SK | Regina Qu'Appelle Regional Health Authority | 4704 | 85 | 4 | 11 | 1 | 2,099 | 89.3 | 17 | 72.3 | 8.1 | 23,506 |
| SK | Sunrise Regional Health Authority | 4705 | 0 | 43 | 57 | 3 | 2,477 | 89.9 | 30 | 108.9 | 12.1 | 27,546 |
| SK | Saskatoon Regional Health Authority | 4706 | 86 | 1 | 13 | 1 | 4,097 | 46.6 | 53 | 60.3 | 12.9 | 87,916 |
| SK | Heartland Regional Health Authority | 4707 | 0 | 4 | 96 | 3 | 1,517 | 37.2 | 11 | 27.0 | 7.3 | 40,797 |
| SK | Kelsey Trail Regional Health Authority | 4708 | 0 | 0 | 100 | 3 | 4,235 | 53.1 | 60 | 75.2 | 14.2 | 79,795 |
| SK | Prince Albert Parkland Regional Health Authority | 4709 | 0 | 69 | 31 | 2 | 11,367 | 41.7 | 152 | 55.8 | 13.4 | 272,509 |
| SK | Prairie North Regional Health Authority | 4710 | 0 | 56 | 44 | 2 | 10,503 | 30.4 | 103 | 29.8 | 9.8 | 346,025 |
| SK | Mamawetan Churchill River Regional Health Authority | 4711 | 0 | 0 | 100 | 3 | 1,638 | 27.3 | 20 | 33.3 | 12.2 | 60,079 |
| SK | Keewatin Yatthé Regional Health Authority | 4712 | 0 | 0 | 100 | 3 | 2,500 | 27.6 | 46 | 50.7 | 18.4 | 90,663 |
| SK | Athabasca Health Authority | 4713 | 0 | 0 | 100 | 3 | 1,031 | 27.2 | 6 | 15.8 | 5.8 | 37,908 |
| AB | South Zone | 4831 | 41 | 38 | 22 | 1 | 11,876 | 36.4 | 124 | 38.0 | 10.4 | 326,645 |
| AB | Calgary Zone | 4832 | 89 | 7 | 3 | 1 | 89,604 | 51.7 | 650 | 37.5 | 7.3 | 1,732,180 |
| AB | Central Zone | 4833 | 0 | 60 | 40 | 2 | 19,344 | 40.4 | 149 | 31.1 | 7.7 | 478,882 |
| AB | Edmonton Zone | 4834 | 100 | 0 | 0 | 1 | 74,986 | 51.3 | 1,060 | 72.5 | 14.1 | 1,461,422 |
| AB | North Zone | 4835 | 0 | 41 | 58 | 3 | 24,721 | 53.3 | 169 | 36.5 | 6.8 | 463,412 |
| | East Kootenay Health Service Delivery Area | 5911 | 0 | 35 | 65 | 3 | 748 | 9.5 | 4 | 5.1 | 5.3 | 78,897 |
| BC | Kootenay-Boundary Health Service Delivery Area | 5912 | 0 | 23 | 77 | 3 | 390 | 4.9 | 3 | 3.8 | 7.7 | 79,362 |
| BC | Okanagan Health Service Delivery Area | 5913 | 54 | 36 | 10 | 1 | 6,375 | 17.6 | 98 | 27.0 | 15.4 | 362,757 |
| BC | Thompson/Cariboo Health Service Delivery Area | 5914 | 0 | 75 | 25 | 2 | 3,423 | 15.7 | 40 | 18.4 | 11.7 | 217,488 |
| BC | Fraser East Health Service Delivery Area | 5921 | 61 | 36 | 3 | 1 | 4,497 | 15.3 | 142 | 48.3 | 31.6 | 293,773 |
| BC | Fraser North Health Service Delivery Area | 5922 | 100 | 0 | 0 | 1 | 16,392 | 25.6 | 372 | 58.2 | 22.7 | 639,196 |
| BC | Fraser South Health Service Delivery Area | 5923 | 100 | 0 | 0 | 1 | 44,415 | 56.6 | 358 | 45.6 | 8.1 | 784,791 |
| BC | Richmond Health Service Delivery Area | 5931 | 100 | 0 | 0 | 1 | 3,670 | 17.1 | 51 | 23.8 | 13.9 | 214,442 |
| BC | Vancouver Health Service Delivery Area | 5932 | 100 | 0 | 0 | 1 | 20,202 | 31.9 | 305 | 48.2 | 15.1 | 633,138 |
| BC | North Shore/Coast Garibaldi Health Service Delivery Area | 5933 | 68 | 14 | 19 | 1 | 3,127 | 11.0 | 90 | 31.7 | 28.8 | 283,825 |
| BC | South Vancouver Island Health Service Delivery Area | 5941 | 96 | 0 | 4 | 1 | 1,461 | 3.8 | 16 | 4.2 | 11.0 | 383,360 |
| BC | Central Vancouver Island Health Service Delivery Area | 5942 | 0 | 96 | 4 | 2 | 2,072 | 7.7 | 19 | 7.0 | 9.2 | 270,205 |
| BC | North Vancouver Island Health Service Delivery Area | 5943 | 0 | 85 | 15 | 2 | 315 | 2.6 | 5 | 4.1 | 15.9 | 122,134 |
| BC | Northwest Health Service Delivery Area | 5951 | 0 | 44 | 56 | 3 | 2,709 | 37.8 | 51 | 71.2 | 18.8 | 71,654 |
| BC | Northern Interior Health Service Delivery Area | 5952 | 0 | 78 | 22 | 2 | 2,327 | 16.5 | 64 | 45.5 | 27.5 | 140,654 |
| BC | Northeast Health Service Delivery Area | 5953 | 0 | 70 | 30 | 2 | 2,074 | 30.6 | 32 | 47.1 | 15.4 | 67,885 |
| YT | Yukon | 6001 | 0 | 79 | 21 | 2 | 84 | 2.1 | 2 | 5.1 | 23.8 | 39,469 |
| NT | Northwest Territories | 6101 | 0 | 47 | 53 | 3 | 125 | 2.8 | 0 | 0.0 | 0.0 | 44,078 |
| NU | Nunavut | 6201 | 0 | 0 | 100 | 3 | 630 | 16.9 | 4 | 10.7 | 6.3 | 37,226 |